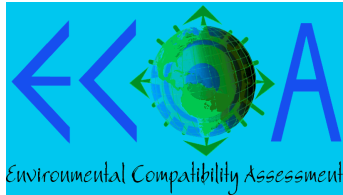


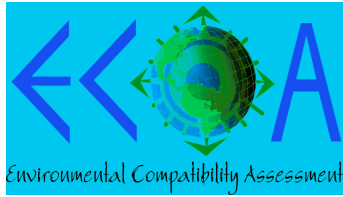
Environmental Compatibility Assessment Workshops

Frank Murray
Workshop Chairman



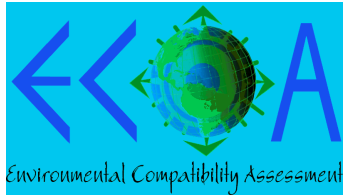
Key Trends

- Growing Popular Concern (National & International) for the Environment
- Rapid Growth Projected in Air Traffic
- Suburban Sprawl



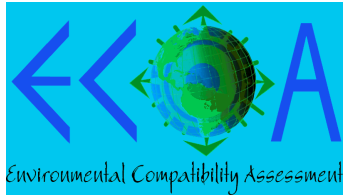
Results

- Growing Public Awareness & Concerns Over Noise & Emissions from Aircraft
- Growing Recognition by our Leaders of this Problem
- International Pressures (Kyoto) to Reduce Emissions



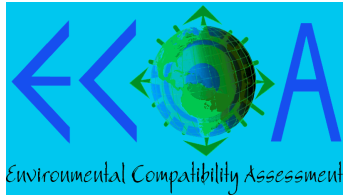
Importance of Aviation to the United States

- Critical to Maintain:
 - Economic Growth & Vitality
 - Travel for Business & Pleasure
 - The Balance of Trade & Leading Manufacturing Exports
 - National Prestige & Aviation Leadership



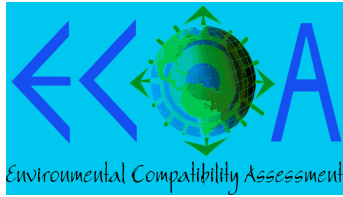
NASA Three Pillar Goals

- Environmental Goals
 - Reduce Perceived Noise Level of Future Aircraft by a Factor of 2 from Today's Subsonic Aircraft within 10 Years
 - ...by a Factor of 4 within 25 Years
 - Reduce Emissions of Future Aircraft by a Factor of 3 within 10 Years
 - ...by a Factor of 5 within 25 Years



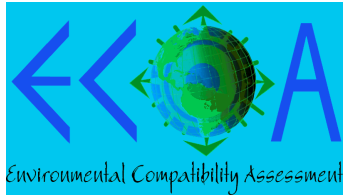
NASA's Response

- In Response to the Challenge, NASA Established the Environmental Compatibility Assessment Program:
 - Establish a Core Team to Coordinate the Research & Technology Development Effort
 - Develop Program Recommendations by September 1998



Core Team Charter

- Assess Feasibility of the Three Pillar Goals
- Evaluate the Contribution of Current NASA Programs
- Identify Technical Solutions
- Set Priorities
- Build Consensus & Advocacy



Core Team Selected

Methodology



- Conduct a Series of 3 Workshops to Include Key Constituencies & Interests
- Present the Broad Problem
- Provide Key Questions to Focus Workshop Efforts
- Engage Participants in Assessing the Contribution of New Technology in Mitigating Environmental Impacts
- Provide Required NASA & Other Technology Briefings to Assist in Achieving Workshop Goals

Must the growth of aviation lead to increased environmental impact?



Workshop #1: Shared learning, coalition building with a large, wide group of participants.

- What are the environmental issues that are likely to impose fundamental limitations on aviation's growth?
- What are the technical challenges faced in eliminating the fundamental limitations to aviation's growth?

“Customer” problems and issues, clarification of “benefits.”

Workshop #2: Review customer needs and benefits, develop roadmaps.

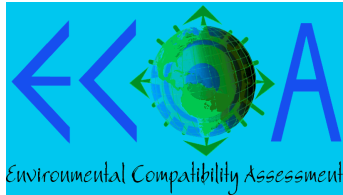
- Review scenarios
- First cut gap analysis
- Strawperson roadmaps
- Customer benefits

Workshop #3: Suggest research and technology areas, refine roadmaps, and chart way forward.

- Review roadmaps
- Priorities - What needs to be started now?
- Fostering creativity
- The way forward

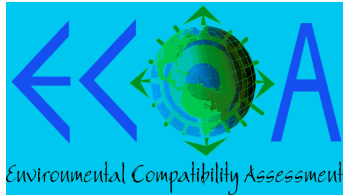
Basis for initiating a search for technology solutions.

Clear program options!



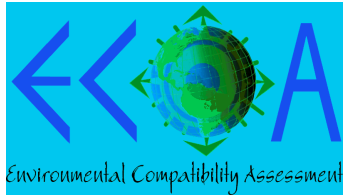
Key Questions

- What are the Impacts of Aviation Noise & Emissions on the Environment?
- How Do You Believe These May Affect the Growth of Aviation?
- Must the Growth of Aviation Lead to Increased Environmental Impacts?
- What is the Relationship of the NASA Noise & Emissions Goals to Aviation's Impact on the Environment?



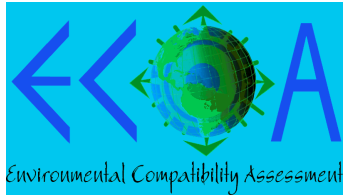
Workshops

- I - Atlanta, GA - March 17-19, 1998
- II - Cleveland, OH - May 19-21, 1998
- III - Monterey, CA - July 7-9, 1998
- Participants (Average: 95/Workshop)
 - **Affiliations Represented:**
 - **Industry**
 - **Airports**
 - **Airlines**
 - **Federal & State Government Agencies**
 - **Environment & Transportation-Related Organizations**
 - **Academia**
 - **Consultants**



Industry Representatives

- Aerodyne Research, Inc.
- Allied Signal
- Allison
- BFGoodrich Aerospace
- Boeing
- General Electric
- Lockheed Martin
- Northrop Grumman
- Pratt & Whitney
- Sverdrup
- TRW
- GKN Westland



Airport/Airline Representatives

- Airports

- Chicago O'Hare
- Dallas-Ft. Worth
- Hartsfield Atlanta
- Los Angeles

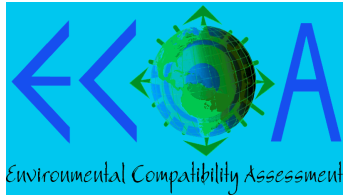
Nashville International
Oakland International
San Jose International
Seattle Tacoma

- Airlines

- Delta

United

America

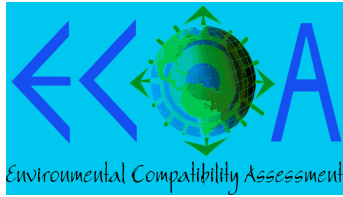


Federal & State



Government Representatives

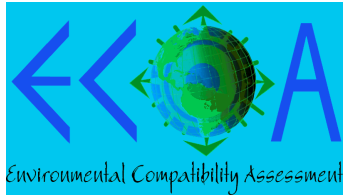
- California Department of Transportation
- Department of Energy
- Environmental Protection Agency
- Federal Aviation Administration
- National Aeronautics & Space Administration
- The White House
- The Port Authority of New York
- United States Air Force



Organization Representatives



- National Research Council/Academy of Science & Engineering Board
- Aerospace Industries Association of America
- Air Transport Association
- Center for Clean Air Policy
- CALSTART
- General Aviation Manufacturing Association
- The Mitre Corporation
- Environmental Defense Fund
- Natural Resources Defense Council

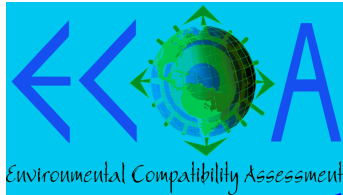


Academia/Consultants



Representatives

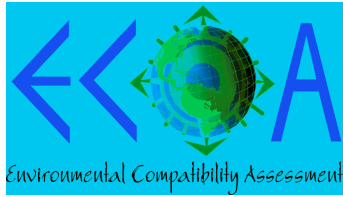
- Academia
 - Georgia Institute of Technology
 - Massachusetts Institute of Technology
 - University of Maryland
 - Wichita State University
- Consultants
 - Camp Dresser & McKee, Inc.
 - Cutler & Stanfield
 - Gailbraith Association
 - GRA, Inc.
 - Landrum & Brown
 - McDermott, Will & Emery
 - Synergy Consultants
 - Transportation Solutions, Inc.
 - Wyle Laboratories



Workshop I

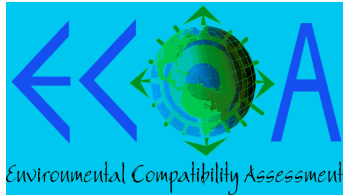
Theme: Define the Problem

- **Noise Breakout Group:**
 - Goals Unclear Vis-a-Vis Perceived Problem
 - Metrics & Models Inadequate
 - Plan Needs to Balance Near & Far-Term Research & Basic & Focused Research
 - No Strategy for Other Deployment Issues (Cost, Safety, etc.) for Success
- **Emissions Breakout Group:**
 - Plan is Needed to Balance Evolutionary & Revolutionary Research
 - System Approach Needed to Maximize the Benefits of New Technology, Operational Improvements & Procedural Changes
 - Improve Methods to Evaluate Trade-offs Between Emission Strategies, eg., NO_x vs. CO₂
 - Need Improved Understanding of Ozone Chemistry



Principles from Workshop I

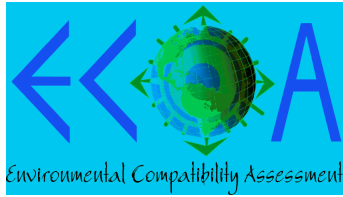
- The Objective is Not to Limit the Growth of Aviation
- Everyone Must “Pay Some of the Freight”
- Levels of Noise & Emissions Must be Clearly Defined



Workshop II

Theme: Exchange Information & Discuss Concepts

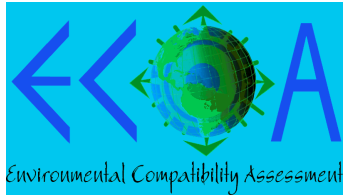
- Provide Briefings on Issues from Workshop I
- Examine Scenarios
- Analyze the Gap (Between Goals & Scenarios)
- Present Strawman Roadmaps
- Propose Technology Concepts



Workshop III

Theme: Feedback

- Assess Strawman Roadmaps
- Revisit Gap Analysis
- Present Final 4 Questions to 3 Breakout Groups:
 - Industry/Consultants
 - Operators/Airports/Airlines
 - NGO/Community/State

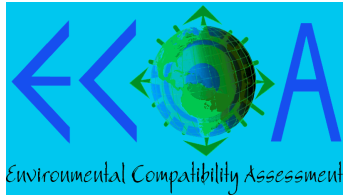


Workshop III

Final 4 Questions



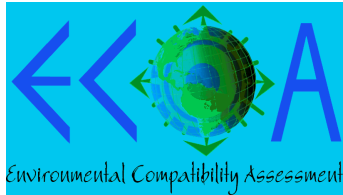
- **Goals:**
 - Will the Attainment of the Goals Satisfy Your Environmental Concerns?
- **Investment Strategy:**
 - Does the NASA Research & Development Strategy Appear to be Appropriate?
- **Roadmaps:**
 - Have the Roadmaps Properly Leveraged On-Going Programs & Reached an Appropriate Balance Between Near-Term & Far-Term Goals?
 - What Programs Need to be Started as Soon as Possible?
- **Moving Forward:**
 - Would a Continuing Communication with NASA Regarding These Issues & Programs be of Value to Your Organization?
 - What Role Would You be Willing to Play in Furthering the Pursuit of These Research Objectives?



Feedback - Goals



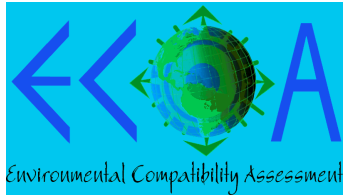
- Will the Attainment of the Goals Satisfy Your Environmental Concerns?
 - Answers Varied From Qualified Yes to a Qualified No. Key Points Included:
 - **Three Pillar Goals are Technology Goals...Public Concerns are Levels of Emissions & Noise from the Fleet of Operating Aircraft**
 - **Other Criteria (Safety, Affordability, etc.) Must be Part of Any Solution**
 - **Appropriateness of the Noise & Emissions Goals are Questioned (e.g., the Use of a 20-dB Reduction for Light Aircraft)**



Feedback - Strategy



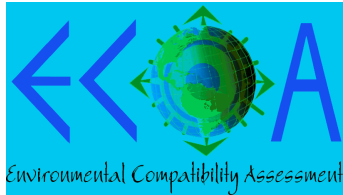
- Does the NASA Strategy Appear to be Appropriate?
 - Generally, the Strategy is Appropriate, as Far as it Goes, but...
 - **Address Other Types of Aircraft**
 - **Funding for Development of Promising Technologies Through Technology Readiness Level 6**
 - **Stronger Research Coordination...NASA & Other Agencies**
 - **Strategy Extended Beyond Research & Technology for Overall Success (e.g., Acceptance, certification, regulation, operations, etc.)**



Feedback - Roadmaps



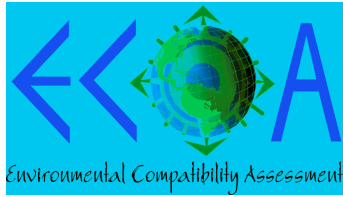
- **Have the Roadmaps Reached Appropriate Near & Far-Term Balance? Identify Technologies to be Pursued ASAP?**
 - **Near-Term Solutions - Focus on Improved Efficiency, Better Models and Systems Studies**
 - **Interim Action - Pursue Operational Improvements (e.g., CNS/ATM) & AST Developments (via Retrofit)**
 - **Far-Term NASA Role is Crucial - “NASA Has a Critical Role to Play in a Basic R&D Program & in ‘Thinking Outside the Box!’” (Zero Emission Aircraft)**
 - **Do Not Pursue Alternative Carbon-Based Fuels - All the Problems Associated with a New Fuel Infrastructure & Few Benefits**



Feedback - Roadmaps (Continued)



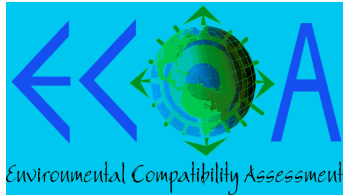
- Leveraged Other Government & Industry Programs?
 - Coordination Not Reflected in the Roadmaps
 - Coordinate with Other NASA Goals (Safety, Cost, etc.)
 - Look at Military Programs
 - NASA Should Take the Lead in This Coordination Effort



Feedback - Moving Forward



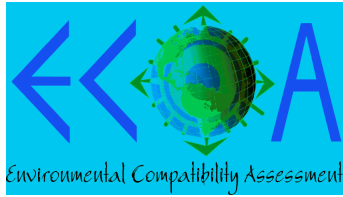
- What Form of Continuing Communication with NASA Would be of Value? In What Way Would You be Willing to Participate in Pursuit of These Research Objectives?
- All Groups...Continue Communication with NASA...Willing to be Actively Involved
 - **Steering Committee Modeled After the AST Noise Steering Group**
 - **Expand Participation to Other Relevant Groups**
 - **Six-Month Progress Reports, Test Results & POCs**
 - **Reports or Articles Understandable to the Layman**
 - **Continuation of the ECoA Website...Add Hot Links**



Feedback - Moving Forward Part 2

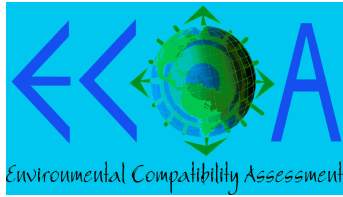


- In What Way Would You be Willing to Participate in Pursuit of These Research Objectives?
 - **Information & Education...Increase Public Awareness & Educate Constituencies & Educate Decision-Makers**
 - **Forums for Discussion at Conventions, Association Meetings....**
 - **Airport Facilities as Test Beds for Development Programs**
 - **Time & Expertise to Review Program Proposals & to Identify Constituent Concerns**



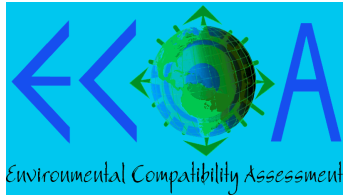
Insights

- Impacts on Aviation Viewed as More Immediate
- Emphasis on Improved Efficiency
- Improved Models (Noise & Local Air Quality) Given High Priority
- Strategies Must Go Beyond Research for Success
- Sincerity & Uniformity Regarding Continued Involvement



Bottom Lines

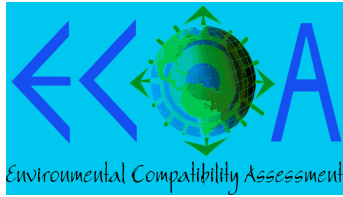
- General Support for the Program
- Want to be Involved & Have a Say
- Are Willing to Step Out Front
- Communication Needs to Continue



Post Workshop Follow-Ups



- **Steering Group - Modeled on the AST Noise Steering Group (Meet Twice a Year)**
 - Senior Strategy Group
 - Two Technical Panels
- **Annual Workshop**
 - Two-Way Information Exchange
 - Two or Three Days
- **Website...Continue & Expand**
 - Program Progress Reports/POCs
 - Layman's Language Reports
 - Calendar of Events



What Next?

The Ball is in NASA's Court.....

